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CONTENTS

People and Oil, by Arthur C. Palmer 65
IP Summer Meeting at Hastings 71
Council Commentary 72
Modern Techniques in Petroleum Testing VIII. By B. W. Swanson 73
Around the Branches 79
Personal Notes 82
Petroleum and the Textile Industry. By F. N. McLaren 87
Forthcoming Meetings 93

PEOPLE AND OIL*

By ARTHUR C. PALMER†

At intervals during the late war, many spent some moments in private reflection. During those moments they tried to anticipate what the world would be like when the guns were silent. No doubt they hoped that it would be a new world, as well as an infinitely better world. Millions shared those hopes. But when peace came, somehow or other it did not quite work out as expected. The world did not appear to have changed a great deal. And once again, millions shared the disillusionment.

To-day it seems that this may well be one of the most fundamental faults in the fabric of post-war thinking. Whether or not we have emerged into a better world is largely a matter of degree, and personal circumstance. But there can surely be no question at all that we *have* emerged, and that we *are living*—in an entirely new world.

It is not only a very new world, but it is also a very dynamic world. For wherever one looks to-day there is the evidence of people's hopes, people's ambitions, and people's aspirations—many of which have lain dormant in the breasts of nations for centuries—erupting to the surface. Everywhere tremendous and deeply significant changes in social, economic, and political patterns are taking place. Ideas, as well as people, are on the march. The tides of public opinion are running at full flood.

*An address to the London Branch, Institute of Petroleum, January 22, 1952.

†Public Relations Manager, Esso Petroleum Co Ltd.

Such a period of universal change, and even revolution in public thinking, is clearly a matter of most intimate concern to the oil industry. In the first place, oil itself has become a completely international commodity. And secondly, an essential feature in the structure of the modern oil industry is that the scale of operations creates the need for large company units, with widespread interests, in order to spread gigantic risks. Oil companies, therefore, must respond to the opinions and pressures of millions of people—if they wish to prosper and survive. In effect, this might be regarded as a condition of their existence.

It is against such a background that these remarks are divided under three main headings : first, the examination of the broad pattern of current world events. Some of the chosen examples may not appear to have an immediate relation to the petroleum industry, but they will, it is hoped, help to give an overall picture of opinions and present-day thinking trends.

Secondly, an examination of the principal underlying causes which appear to have stimulated these movements and upheavals in mass thinking, and national behaviour.

Thirdly, certain suggestions will be considered which it is felt should be adopted if, as an industry, we are going to progress and make the maximum contribution to the various communities in which we serve.

In the opinion of many competent observers, one of the most confusing and disturbing scenes in current world affairs, is the continent of Asia. Within this vast territory of nearly 17 million square miles, there are grouped no fewer than 1300 million people, the great majority of whom are living in a state of violent emotional turmoil.

Dominating Asia today is the new People's Republic of China—Red China. Under fanatical leadership, Chinese armies have liquidated the former democratic régime of Chiang Kai-shek, spilled over into Tibet and into Korea. Chinese bayonets are also now poised ominously on the borders of Thailand and Indo-China. Here is one nation, of some 463 million people, marching on to a new destiny.

Further south, in the troubled lands of Malaya and Indonesia, extremist and terrorist groups are with difficulty being held in check. Many of these groups are in open sympathy with China, and all of them are inspired by Chinese successes on the mainland.

Notwithstanding the fact that all these people, including the Chinese, were but recently rescued by the Allied nations from complete Japanese conquest—the unhappy truth is that throughout this area to-day, citizens of the Western countries are resented, despised and, not infrequently, murdered.

Principally because she is desperately short of rice for her people, China clearly aims to expand her influence, and perhaps even to exert control over most of the Asian continent.

By contrast, the newly-formed governments of India and Pakistan are almost wholly occupied with their own internal problems. Here the atmosphere is calmer, and ill-will towards the West is much less pronounced. But these two countries are divided by deep religious differences. They live perilously, and continuously, on the brink of bloody civil war. Over both countries stands also the constant spectre of famine, which might well be the spark to ignite yet another highly explosive area.

Further north, in Persia, recent events are too well-known to need comment in detail. But it may be of some interest to mention that, to-day, the Persian people are being told by their political, and more especially by their religious leaders, that for centuries the nation subsisted without an oil industry, and that therefore it can do so again. To Western ears, this may well sound like

the very midsummer of economic madness. But to the Persian people it appears to make sense. Such is the gulf that now exists between Persian and Western ideologies.

More recently still, Egypt has become the focal point for extreme nationalistic expression. To many in the West the real dispute in Egypt is obscure. But the Egyptian people are in no doubt as to its nature, or its purpose. Listen, for example, to Azzam Pasha, secretary-general of the Arab League, voicing the Egyptian case: "No force," he declares, "can stop the will of 20 million Egyptians, who refuse to be humiliated any longer."

However, the significance of the Egyptian crisis has deeper roots even than this. Cairo, through the centuries, has regarded herself as the vortex, and indeed the Vatican, of the world of Islam. And to-day the followers of this faith, representing one unified group of 660 million people ranging from the Atlantic coast of Morocco, right across Africa and Asia to the Philippine Islands in the Pacific—are being inspired by their leaders to return to the original teachings of Mohammed and to sever all relationships with the West. Persia is among those nations who devoutly support the Islamic faith.

Although many of these upheavals appear to be centred round the peoples of Near Eastern and Far Eastern countries, it would be a mistake to imagine that to-day these are the only areas of significant human conflict. Profoundly important movements can also be observed in Latin America.

In the Argentine, for example, a strong dictatorship régime, with some strangely familiar trappings, is now firmly entrenched—despite a recent attempt to overthrow it. Prominent newspapers have lost their democratic freedom of expression. Business organizations thus have restricted opportunities of communicating themselves to the public.

Again, in Brazil, after a protracted campaign to enlist public support for a semi-nationalized oil industry, Congress is about to vote on a proposal to exclude all foreign capital from developing the country's considerable oil resources.

Nor is it necessary even to cross the Atlantic to discover similar impacts of political pressure groups upon the industrial life and progress of nations. Here, in the U.K., are plenty of recent examples of what can happen to the ownership of key industries, and of the threats which can be held over the heads of others.

What, then, has brought all this about? Why is it that we have become enveloped in such an infinitely complex struggle for survival? And, perhaps more pointedly, how should we, in the oil industry, set about shaping our own future in such a confused world as this?

The most realistic answer to the first two of these questions is undoubtedly the staggering expansion rate of world population. How many have realized that at the beginning of the nineteenth century the total population of the world was estimated to be rather less than one thousand million people. Only 150 years later, that is to say in 1950, this figure had been doubled. By the end of the twentieth century—in just under 50 years time—it is expected that world population will even exceed three thousand million. In other words, during the next 40 odd years, the increase in population will alone be greater than the entire world population was in 1800. Moreover, with one or two exceptions, these startling figures maintain a reasonable uniformity throughout every country.

Here is the rock of reality. The plain truth is that to-day there are millions of new mouths to be fed, and millions of new bellies to be filled. For let us not forget that all these people have a very healthy desire to live in a world which itself remains static in size.

Inescapable as that reason is, however,

we must go further and deeper to analyse our problem. For men do not live by bread alone. They have souls. They have dreams. They have creative impulses. They have a sense of dignity and personal pride. They have longings for the respect and regard of others. They have desires for security. And civilization, in its supreme ignorance, has overlooked many of these things. And with what result? Faiths have been shattered. Hopes have been mutilated. Dreams lie in heaps of rubble underneath our feet. And in their places, moroseness and bitterness stalk through the world.

There is yet a third reason which we should be wise to recognize. During this century our means, and our methods, for communicating with unprecedented numbers of people have enormously expanded. Books and pamphlets, newspapers and magazines, films and photographs, radio and television, exhibitions and educational programmes—in a never-ending stream the words pour out to capture the attention, and it is hoped the sympathetic support, of those who are addressed.

But here is a surprising thing. Although it is due largely to the initiative and the enterprise of business brains that these new media have been evolved, it is predominantly the politicians and the demagogues who have exploited these powerful weapons for influencing and capturing the minds of millions. It has been the Hitlers and the Mussolinis, and more recently the Communists, who have been quick to see the profound effect, and the critical importance, of directing and controlling mass opinions through such methods. Only tardily, and somewhat half-heartedly, have business and industrial interests observed the immense struggle and the intense competition, which to-day exists for public support and public confidence through these newly-developed channels of communication.

Out of all discussed so far there emerges now a reasonably clear pattern. For want of a better term this pattern can be described as an outline programme of human relations for the oil industry. This programme seems to fall into three fairly well-defined sections.

The first section, perhaps surprisingly, has to do just with ourselves. Under the conditions in which we find ourselves to-day, one of our primary duties is to train ourselves to think politically; that is to try constantly, in everything we do, to think in terms of other people's interests, rather than in our own. This is not an easy thing to do. But the facts are that survey after survey of public conceptions of business reveal that large numbers of people regard us as a self-interested group, and with little regard for public interest. And let us just remember here that, in a democracy, this need to think in terms of others is absolutely imperative, since it is the people who are sovereign and who always hold the ultimate control of power.

Another need we all have is to equip ourselves with a rich fund of knowledge —not only about our own job, but about the companies for which we work and especially about our industry, and the very considerable contributions which they make to the communities in which we operate. Far too many to-day are content to do, and to know, just what the immediate task requires and no more.

A third requirement, and one on which special emphasis is laid, is the need for all of us to believe in what we are doing—to build up strong reserves of faith in our companies, our industry, and in ourselves. Again, this is not an easy thing to do. But it is an essential requirement. For if we, who are the oil industry, do not believe in ourselves —and in what we are doing—how can we expect others to believe in us? To digress for one moment, and give an example: the other day one of the most distinguished envoys from the Leb-

anon, Charles Malik, was addressing the United Nations. To the assembled delegates he said:—

> "Do you know why there are problems in the Near East? I will tell you. It is because the West is not sure of itself."

There are just two further points in the personal section of this programme to mention. The first is that equipped with our knowledge, and supported by our faith, we should then do our utmost to extend our range of personal contacts. We should seek out and develop every opportunity of convincing others of the contributions we are making to the society in which we live. This does not, of course, mean boasting. Nor does it mean arrogance. It does mean conveying our story skilfully, and with dignity, and restraint.

The other point is this. Oil is a tremendous industry. But all our mammoth transactions, in the long run, have to be conducted with individual human beings. And in such dealings it is the little things we do which enable others to assess our true worth. It is the letter of appreciation which strictly doesn't need to be written. It is the telephone call to say no more than "Thank you" which wins friendship and esteem. For these, after all, are the simple marks of sincerity.

Individuals, therefore, can do much to gain for our industry the respect and the confidence which we need. But companies can do even more, and this brings us to the second section of our programme.

For reasons already seen, companies, and especially oil companies, can no longer live in economic isolation. They have become part of the social climate of their time, and their policies and actions affect the character of that climate importantly.

Progressive companies to-day have thus come to accept many of the obligations traditionally imposed upon the individual citizen. They concern themselves with staff and community welfare, with training and educational schemes, with pension and retirement programmes, and with many other activities going far beyond a strictly economic concept of business functions.

The sad truth is that such facts as these, and many others, are barely known beyond those immediately concerned. Therefore, one of the most urgent needs is for companies to adopt organized and deliberate programmes for carrying this information to the public, and perhaps it might be added, especially to their own staffs.

If public confidence and public trust is the goal, then clearly, in the first place, we must deserve it. That is to say our performance must be the platform from which we start. But under to-day's conditions, performance by itself clearly cannot secure recognition, unless it is publicly reported. Our good deeds essentially must be followed by good words. And again it must be stressed that this does not mean distortion or flamboyant displays in bad taste. It means strictly objective reporting of a company's actions and policies, as well as the reasons which produce them. It also means the strict observance of complete truth.

Nobody can say that the means of conveying this information to millions of people are not available to us. And quite certainly we are not deficient in the appropriate arts. All we appear to lack is the will.

The final proposals in this programme concern the actions which might be taken by the whole British oil industry, acting as one collective group.

It is a very remarkable thing that in Great Britain oil is rapidly becoming one of the major industries. In barely 13 years national oil consumption has been practically doubled. Huge new refineries are being erected. Thousands of new jobs are being created—and will require a continuity of trained men

to fill them. An immense programme of refinery equipment and new tanker construction is under way. And yet, in spite of all this, and in spite of the highly critical political tension of the country—the petroleum industry has no unified voice to address to the public. It is a deficiency which should be made good in a great hurry.

During a recent visit to America some time was spent discussing this matter with members of the American Petroleum Institute, and the Oil Industry Information Committee. It was astonishing to find that this Committee, which incidentally was set up and is financed and administered by the API, spent during 1951, nearly a million pounds on public oil information programmes.

These programmes were initiated and carried out by a staff of no less than 80 full-time executives, and the Committee was financially supported by practically every single company in the industry, including many hundreds of garages and service stations.

Public opinion surveys, speeches, press reports, magazine articles, advertising campaigns, community events, film shows, exhibitions, and display material of every conceivable type, are being used in this tremendous drive to give the whole American public an opportunity of knowing what the oil industry is about, and the achievements which stand to its credit.

Perhaps it might be of some interest to quote the following extract from the API handbook defining the objectives of this group:—

"The Public Relations Committee of the Board of Directors supervises public-relations policies and activities of the Institute and also serves as administrative and financial agency for the Oil Industry Information Committee. Recognizing that a successful public-relations programme for the oil industry should be designed to benefit the entire industry, the Public Relations Committee took the initiative in establishing the Oil Industry Information Committee as an instrument for co-ordinating a programme of public information regarding all segments of the industry.

"The Oil Industry Information Committee's task is to administer a comprehensive public information programme through publicity, advertising, literature, speakers' groups, and other media. Its work is supported financially and by policy by the Institute and by numerous other organizations, companies, and individuals in the oil industry. The committee seeks to represent all segments and areas of the oil industry in the United States. Its objective is to further a broad public understanding of the oil business and the people who work in this industry, in order to promote the common interest of all parts of the oil industry in maintaining freedom from government control and excessive regulation. Such freedom is necessary for a vigorous, progressive industry serving the public welfare of the nation. The Oil Industry Information Committee does not attempt to deal with industry operating problems, recognizing they are the province of individuals, companies, other groups, and associations that may be concerned."

It is not suggested that we, in Britain, should follow slavishly the American pattern. Much of the work the O.I.I.C. is doing would not be acceptable in Britain. But the principle behind this activity is undeniably sound. Indeed it is my very sincere hope that our own Institute may see fit to consider sponsoring just such a group as has been described, even though in the first place its membership and its activities may obviously be less ambitious. For there is no other group of oil men in Britain who can claim to be so thoroughly representative of every aspect of our industry.

To my mind the future of the British oil industry, in the hands of competitive enterprise, is directly dependent on its ability to deserve and to secure an entirely favourable climate of public opinion. That is a formidable task. It is also, of course, a continuous task, worthy at least of a serious analysis and a comprehensive approach.

To summarize, very briefly, the principal points examined:—

We are living in a new world. It is a world of swiftly-moving events and

ideas. It is also a world in which population is expanding at an alarming rate. It is again a world in which, for a variety of reasons, many large groups of people are morose and bitter. It is also a world in which, largely because of vastly improved methods of communication, there is intense competition for favourable public opinion.

If we are to survive in this world our industry needs, and must have, a large measure of public confidence. As we have seen, all of us can play important individual parts in bringing this about. In fact, this is a job from which no one can be spared, and from which no one is exempt.

But the greatest common enemy is ignorance. Around this industry of ours, for example, there are great swamps of ignorance—and we have created them. These are the breeding grounds for mosquitoes of mistrust. And it is these insects which infect the minds of men, and distort the attitudes of those whose confidence we seek.

Our fundamental task is to drain those swamps. With a united effort we will do it. Quite certainly we *must* do it.

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IP SUMMER MEETING AT HASTINGS

Hastings has been chosen this year as the venue for the Institute of Petroleum's week-end summer meeting, to be held from Friday evening, June 27 to Sunday afternoon, June 29.

Three talks by eminent authorities on the broad theme of "Oil, the Task Ahead" will be given during the week-end, and on the social side there will be a varied and interesting programme.

A cocktail party will launch the meeting, followed by the opening address and first talk. On the Saturday morning two more talks will be given, the afternoon being devoted to a trip to historic Bodiam Castle and Battle Abbey and tea in the charming town of Rye, one of the ancient Cinque Ports. A dinner-dance is arranged for Saturday night.

On Sunday morning a golf competition, open to ladies and gentlemen, will take place on the world-famous course at Rye and the meeting will end on Sunday afternoon with tea and an address by the President of the Institute.

In addition to the set programme, visitors will find plenty to do in Hastings, which is famed for its high average of sunshine. The town has its full share of concert parties, cinemas, and other entertainments; there is much of historical interest to be seen in the vicinity, and the surrounding countryside is varied and beautiful. There are six golf courses within a ten-mile radius.

The meeting is limited to Institute members and their wives and those wishing to attend are advised to make early application to the General Secretary of the IP. All-in charge is £5.0.0 per person, inclusive of first-class hotel accommodation, meals, cocktail party, dinner-dance, and afternoon tour.

In planning the meeting, the Council had in mind particularly overseas members of the Institute who may be on leave in England during the time and may wish to take the opportunity of meeting fellow members. Therefore 40 places are being set aside until April 30 to allow applications from abroad to be received.

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NEXT WORLD PETROLEUM CONGRESS

The Fourth World Petroleum Congress will be held in Italy, probably in Rome, during June 1955.

COUNCIL COMMENTARY

The President was in the Chair for the January Council Meeting held on January 9. Members of Council were delighted to see Mr J. A. Oriel once again and their feelings were adequately expressed by the President's words of welcome.

The President's Committee, considering the selection of a President for the 1952/3 Session, had unanimously proposed Mr H. S. Gibson, C.B.E., for this honour and Council unanimously endorsed this recommendation. Mr Gibson is managing director of the Iraq Petroleum Company and since his return from Persia a few years ago has taken an active part in Institute affairs.

A request has been received by the Institute for permission to found a South-Eastern branch centred on Rochester. Mr Thornley, Chairman of Branches Committee, and the General Secretary, have visited Rochester and met the Branch Provisional Committee. As a result of this meeting, he recommended to Council that the Committee provisionally be authorized to proceed with the formation of a branch. This recommendation was accepted and a grant of £20 for initial expenses was approved.

Discussions are also going on in France over the desire of the Institute Française des Techniciens du Pétrole to form a technical body to deal with French standardization matters. They have asked for the help of the IP in forming a body on the lines of the IP Standardization Committee. The President, Colonel Auld, and the General Secretary are meeting the representatives of the French Society to discuss these matters, at present on an unofficial basis.

The Publications Committee have reported that it is not possible to organize a Summer Meeting for 1952 as there would not be time to collect the necessary technical papers. Council, however, reiterated its desire for such a meeting in 1952 and asked the Public Relations Committee to organize this. On this occasion, technical papers would not be presented but addresses by well known authorities would be arranged. The Publications Committee was asked to proceed with arrangements for a Summer Meeting to be held in 1953, at which technical papers would be discussed.

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ADEN REFINERY

Anglo-Iranian Oil Co are investigating the possibilities of constructing a refinery at Aden with a probable annual capacity of 5 million tons. Early in February a survey party of four, headed by S. E. Evans of the geological staff, went to Aden to join a party of four personnel, engineering, and administration representatives led by J. McV. Luard.

DRILLING IN PAPUA

At No. 2 well, Hohoro, South Papua, casing of $6\frac{5}{8}$ inches has been successfully landed in the well at 9975 ft. Landing of the casing has been accomplished in unusually different circumstances, chief among them being squeezing by the strata formations and ioss of mud circulation. Field operations are under the direction of A.I.O.C's general fields manager, H. L. J. Hunter.

MODERN TECHNIQUES IN PETROLEUM TESTING

VIII. INORGANIC ANALYSIS

By B. W. SWANSON*

With the introduction of leaded gasolines, additive oils, and the use of residual oils as fuels for internal combustion turbine engines, inorganic analysis has taken on a new importance for the testing of petroleum and its products. The analyses required fall into groups as follows:

(*a*) *The analysis of additive concentrates and their blends in oils and fuels.*

(*b*) *The detection and estimation of trace elements in crude and blended oils and fuels, including the examination of used oils for corrosion and wear products.*

(*c*) *The analysis of diverse types of engine deposits ranging from oily sump sludges and ring groove deposits to combustion chamber deposits and the small deposits on the points of sparking plugs.*

Each of these groups requires a certain amount of specialized treatment. Methods must be chosen to suit both the samples and the accuracy required and during recent years many new chemical and instrumental techniques have been applied to the solution of the problems involved.

With instrumental methods, the precision varies from approximately 3 per cent on most normal polarographic procedures and 5 per cent for the majority of colorimetric methods to as much as 50 per cent or more on the less precise of the spectrographic methods. This generally limits the use of all these procedures to the determination of minor components, and to the analysis of very small samples the size of which governs the procedure and the accuracy that can be expected from the analysis. For the analysis of major components in additive concentrates and engine deposits chemical methods are to be preferred. However, as the development of instrumental techniques advances an improvement in this state of affairs can be expected, and already in one special case[1] (the analysis of metallurgical samples) "chemical" accuracy has been claimed for the spectrographic determination of major components.

(a) To cover the first group of methods a number of chemical procedures which can be carried out with the minimum of apparatus have been introduced into the "Standard Methods" of the Institute of Petroleum during the last few years. These methods, IP 110/47, 111/49, 115/47, 117/47, 118/48, are based on standard chemical techniques, and are intended for the estimation of single elements in new oil blends containing additives, but by suitable adjustment of the sample size can be readily used for the analysis of additive concentrates. They are not intended for the examination of used oils where varying amounts of foreign inorganic material may have been introduced during use.

(b) The examination of used oils introduces the second group of methods —the estimation of mixtures of minor or trace components. In an attempt to cover this group the ASTM published three methods, ASTM D 810-48, D811-48, and D 1026-49T, which are largely chemical in nature and require very careful manipulation of the numerous separations involved if accurate results are to be obtained. However, for most minor component analysis, unless very large quantities of oil are available the amount of inorganic material present is much too small for this type of pro-

*"Shell" Refining and Marketing Co., Ltd, Thornton Research Centre.

cedure, and methods specific for each component and applicable in the presence of all possible interfering elements are required. It is in this field that instrumental methods based on emission spectroscopy, colorimetry and various electrical measurements have proved of very great value.

(c) No attempt to publish a standard method for the analysis of engine deposits has yet been made, and it is doubtful whether such a method would be of much value in this field. Most samples require individual treatment and so any standard method could only be concerned with broad outlines.

Preliminary Treatment of Samples

Except in the case of certain spectrographic methods the necessity for obtaining a solution suitable for inorganic analysis is always the first problem in this field of analysis. The obvious method of ashing, either alone or in the presence of sulphuric acid or zinc oxide, has been used in most of the standard methods to date. However, dry ashing of large amounts of petroleum can be a very dirty and objectionable operation, and where volatile components are present of rather doubtful value.

Standard methods (ASTM and IP) for lead, iron and copper sought to overcome this difficulty by wet oxidation of the oil using sulphuric and nitric acids. A maximum of some two grams of oil is all that can be conveniently treated by this method and it must therefore be followed by sensitive and accurate analytical procedures. Fortunately, many such methods are available and will be discussed under separate headings.

Other preliminary treatments based on acid extraction have been investigated. Hydrochloric acid, ASTM D 526-48T, or IP 96/51, and Schwartz, IP 116/49, reagent, originally developed for the extraction of lead from gasoline, have been used with limited success for the extraction of inorganic components from solutions of petroleum products in petroleum spirit, but they are not suitable for universal application, being influenced by the type of oil and by the component being extracted.

An interesting procedure[2] which shows some promise is based on ion exchange in non-aqueous solution and has been used for the separation of ionic metals from oil and for the separation of ionic lead from tetraethyllead in used oil. The sample is diluted with *iso*propyl alcohol-benzene mixture and percolated through a column of strong acid ion-exchange resin (Zeocarb 215). The column is then washed free from organic material and the metal extracted with hydrochloric acid. By varying the strength of acid used preferential extraction and separation of alkali metals has been obtained[3].

The difficulty of obtaining a homogeneous and representative sample in the analysis of oily deposits and sump sludges is very great and it is preferable to divide the whole sample into fractions, each of which is then analysed separately. Water is first removed by azeotropic distillation, then the insolubles are removed on the centrifuge and finally the oil is recovered by evaporation of the solvent from the clear solution remaining. The homogeneous fractions thus obtained can then be sampled and analysed.

Emission Spectroscopy

The energy emitted from a thermally or electrically excited element can be resolved and recorded by means of the spectrograph to give a line spectrum characteristic of the excited element, while the intensity of the energy of any individual line varies with the concentration of the excited element and can be used under closely standardized conditions for its estimation. Moreover, provided the resolution of the spectrograph is sufficient to separate the lines, most of the common elements

can be detected and estimated by this procedure without initial separation, although corrections for mutual interference may be required.

In 1948 the Institute of Petroleum published a tentative spectrographic method, IP 122/48T, using electric arc excitation for the detection and quantitative estimation of a large range of minor or trace elements in the sulphated ash from petroleum products. Since this method uses copper electrodes and iron as an internal standard a slightly modified version (IP 120/48) of ASTM method D 810-48 was included for the estimation of these elements and for lead, which is partly volatilized during the ashing process and cannot therefore be estimated by the spectrographic method. Owing to the complex line spectrum of the iron internal standard a spectrograph of high resolving power such as the Hilger Littrow spectrograph is required for this method.

A method which avoids the initial ashing process has been published by Calkins and White[4], who absorb the oil on porous graphite electrodes which are then sparked on the spectrograph. This procedure slightly modified has been used in these laboratories for the estimation of barium, calcium, zinc, and phosphorus in new unused oils and for the estimation of various soluble metals in used oils. It does not determine insoluble inorganic material suspended in used oil; this must be removed prior to absorbing the oil. Also on account of the varying volatility of the different soluble lead compounds it is not satisfactory for the determination of this metal.

In the absence of large amounts of ferrous metals, when estimating the more common additive metals it is not necessary to use an instrument of such high resolving power as the Littrow; good results can be obtained using a medium spectrograph with the background and the CH bands as internal standards.

For the estimation of certain metals, a less intense method of excitation can be used, as in the Lundegardh flame technique[5,6] where an aqueous solution of the metal salt is atomized in the air flow to an air/acetylene flame, when the metal imparts its characteristic radiation to the flame. The energy is resolved on the medium spectrograph and the line spectrum is measured in the normal manner. By using illuminating gas in place of acetylene a lower flame temperature is obtained[7], thus only the alkali and alkaline earth metals are excited and their characteristic radiations can be isolated by the use of filters. The flame photometer embodies a modification of this technique using photoelectric cells in place of the photographic plate for the detection and estimation of the radiation. Instruments of this type are usually direct reading, and numerous commercial models are available.

Among the main advantages of the flame technique is its ability to detect and determine mixed alkalis without the need of tedious and often doubtful separations. Suppression or enhancement of individual lines can be produced by mutual interference of elements, and this aspect of the method has received careful study. Many articles on the reduction or correction of some of these errors have appeared in the literature[8,9].

Spectrophotometry

The practice of using the colour of a solution for the estimation of the element or group of elements responsible for the colour has been common in analytical chemistry for many years. In such methods the unknown colour is matched against standard solutions either in Nessler glasses or in an optical colorimeter, or against standard colour glasses when using the Lovibond Tintometer or Nessleriser. Since all these methods are based on visual colour observation they are subject to all the

errors that may be associated with it, and moreover the final estimation can only be made after all interfering radicles have been eliminated.

By measuring the absorption of light of a definite wavelength, or of a band of narrow spectral width, as it passes through the solution, interference from other colours can be largely eliminated, and further by using photo-electric cells a greater range of absorption measurements can be made more accurately and largely independent of the human element. These improvements have been incorporated in the photo-electric spectrophotometer of which the following two types are available:

(a) Those which provide a light beam of narrow spectral width by means of slit mechanisms, with prisms or diffraction gratings and which are suitable for the measurement and recording of complete absorption spectra (e.g. used in ultra-violet and infra-red absorption analysis).

(b) Those which use a series of filters to produce a light beam of much greater spectral width than type (a).

This latter class of instrument, of which the Spekker photo-electric absorptiometer is a typical example, is very convenient for chemical analysis. However a simplified diffrating grating instrument, Unicam S.P. 350 Model D.G. spectrophotometer, is available and is suitable for chemical analysis. It covers 400-700 milli-micron region and by using a diffration grating with fixed slit has an approximate band width of 35 millimicrons.

The value of these instruments was very well demonstrated by Vaughan and his collaborators who published[10] a scheme for the rapid analysis of alloy steels based on the Spekker and using a minimum of chemical separation. This was followed a year later by a second monograph[11] where the method was further extended, while micro procedures and an alternative light source were introduced. Two years later Haywood and Wood in their book on metallurgical analysis by means of the Spekker[12] extended Vaughan's method to the analysis of ferrous, copper, aluminium and magnesium alloys. These methods were primarily intended for the analysis of metallurgical samples, but they can be applied to the analysis of petroleum products by using the aqueous solutions obtained by the methods described above.

Many colorimetric methods have appeared in the literature, and most metals of interest to the petroleum industry can be estimated by this procedure. Typical examples are the absorptiometric determination of aluminium[13,14], magnesium[15], and phosphorus[16].

Meanwhile Isbell[17] has described modifications to the Spekker designed to increase its accuracy and reliability. The improvements include a linear scale, slow motion drive, and an improved lamp housing.

Electrical Measurements

Among the many analytical methods which depend upon electrical measurements several are of particular interest and have been used in the analysis of petroleum products.

Polarograph

Since its introduction by Prof. I. Heyrovsky in 1924, the polarographic technique, based on the electrolytic reduction of ions in solution at a dropping mercury cathode with either a mercury pool or calomel electrode as anode, has proved to be of great value in industrial analytical practice. If a gradually rising negative potential is applied across the electrodes, the current through the cell increases in a series of steps, each equivalent to the reduction stage, peculiar to one given metal. Under closely standardized conditions the increase in current (e.g. height of step in the current/voltage curve) at any particular step varies with

the concentration of the ion being reduced and can be used to measure its concentration. The voltage, or more correctly the half wave voltage, of any step is characteristic of the ion for any particular "base solution" and if the potentials of the subsequent steps are separated from each other by -0.2 volts or more it is possible to measure a series of different ion concentrations in the same solution. The so-called "base solution" is an electrolyte containing an ion which has a more negative reduction potential than those being investigated, and which must be present in at least a tenfold concentration over that of each ion being estimated. Unfortunately no universal base solution is known and therefore a complete simple scheme of qualitative analysis is not possible by this technique. However, under the correct conditions this procedure offers a very sensitive and quick method of estimating trace elements.

The earlier work on polarography was carried out mainly by manual procedures, but the instruments available at present use either photographic or pen recording mechanisms for recording the current/voltage curves. Few published data on polarographic procedures of specific interest to petroleum testing have appeared, but many of the other published procedures can be easily adapted, and an excellent book on polarography[18] is available. Most metals of current interest can be determined by this procedure, the detection and estimation of zinc which can be carried out at a concentration as low as 1:5,000,000 of solution is a typical example.

A method for the estimation of mixed alkaline earth metals has been reported[19] and although individual alkali metals cannot be estimated the total alkali content has been determined using a quartenary ammonium salt as the base electrolyte. However, owing to the high reduction potential of these elements, and the difficulty of obtaining the "base electrolyte" sufficiently pure at reasonable cost, the flame photometric method is to be preferred.

Electrometric Titration Methods

The change of electrode potential, current and conductivity of the electrolyte in a cell during titration have all been used to indicate the "end point" and are especially useful in dark-coloured solutions where colour indicators are of little value. Potentiometric titration using glass/calomel and glass/silver electrode systems in both aqueous and non-aqueous solution are of particular interest to the petroleum chemist. The glass/calomel system has been used to determine the acidity of petroleum products[20] in a single phase, virtually non-aqueous mixture, and a new function, the CG value, which corresponds to the pH in aqueous solutions has been introduced. A similar procedure has since been introduced as a tentative method by the ASTM. Further examples of titration in non-aqueous solution are the direct determination of salt in crude oil[21], and the titration of sulphur and mercaptans in gasoline[22], methods using either glass/silver or mercury/silver electrode system.

The high resistance of the glass electrode system requires that the measuring apparatus should be capable of working at a current of 5×10^{-12} amps and a suitable instrument especially designed for titration has been described[23].

Titration of halogens in aqueous solution using a glass/silver electrode system in slightly acid solution, offers a simple direct procedure for the determination of mixed halogens and can be readily applied to IP 118/48 when mixed halogens are to be determined.

Amperometric titration based on the change of current at the equivalence point, has certain advantages over potentiometric titration and direct polarography. It can be used with a

high degree of accuracy in dilute solution, and the apparatus required is simpler than for direct polarography over which it gives somewhat more accurate results. It has been used in the titration of lead (by chromate), in the oxidation/reduction titration of vanadium and chromium, in the titration of halides, and in the titration of mercaptans with silver nitrate[24].

A titration procedure using a high frequency oscillator and giving similar results to conductivity titration has been described[25,26] and owing to the absence of electrodes in the solution should find many applications.

Finally the "dead stop" end point, using the polarization of an electrode to indicate the end point, is also useful in dark solutions and has been used in the Karl Fischer method for water[27] and in the bromide-bromate direct titration method for bromine number.[28]

In a short article of this sort it is possible only to indicate the various methods which have proved of such great value in the inorganic analysis of petroleum products. Attention has been focused on advances in instrumental methods, and little has been said about new organic reagents. It will be realized that many of these are used in the colorimetric, polarographic, and titration procedures described above.

Acknowledgement

The author wishes to thank the "Shell" Refining and Marketing Co, Ltd, for permission to publish this survey.

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AUSTRALIAN REFINERY

Broad agreement is reported to have been reached between the Commonwealth and West Australian governments and the Anglo-Iranian Oil Co regarding the plan for a refinery near Fremantle. The proposed refinery is to process 3 million tons per annum of Middle East crude.

AROUND THE BRANCHES

London Branch

On the evening of January 22, the London Branch held a meeting at Manson House at which a paper entitled "People and Oil" was read by A. C. Palmer, Public Relations Manager of the Esso Petroleum Co Ltd. In the unavoidable absence of the Chairman, the meeting was presided over by A. W. Deller, the Vice-Chairman.

In a most interesting and thought-provoking paper (which is reproduced in full elsewhere in this issue, pp. 65-71), Mr Palmer dealt in some detail with the field of oil industry public relations —an aspect of the industry's activities which was relatively unfamiliar to the majority of members of the Branch.

The many interesting features of Mr Palmer's paper gave rise to a long and informative discussion, at the conclusion of which Brigadier B. M. Archibald proposed a vote of thanks which was carried with enthusiasm. After the meeting there was the usual informal party at the Bolivar Restaurant which is now becoming an accepted custom of the Branch; many members remained to have dinner, to which Mr and Mrs Palmer were entertained by the Branch.

Northern Branch

The Annual General Meeting was held on January 15, with 50 members in attendance. H. H. Ballard, chairman, presenting his report for 1951, said that if they were to retain their proud position as the largest Branch outside London, it was essential that new members be recruited. He thought that their aim should be one recruit from each member during 1952.

Expressing his thanks to the Committee as a whole, Mr Ballard said no chairman could have a better team and he was grateful for the help and guidance he had received. In particular he referred to the honorary treasurer, E. R. Wilson, and to the honorary secretary, G. M. Davies, and to both he expressed not only his own gratitude, but that of the Branch also.

On the motion of Mr J. E. Haslam, seconded by T. W. Ranson, the report was adopted with acclamation.

The honorary treasurer's report was presented by E. R. Wilson and unanimously adopted on the proposal of T. G. Provest, seconded by L. Glendinning.

Four nominations having been received for the four vacancies on the Committee, the following were declared elected members of the Committee: G. M. Davies, T. W. Ranson, R. D. Streeton and E. R. Wilson. Messrs R. S. Bickerton and H. E. Lewin were unanimously elected auditors.

Following the A.G.M., V. M. Farrant spoke on "Technology and the Salesman." The men responsible for the marketing of fuels and lubricants should not only be acceptable to buyers for their personalities, but should possess more hard-won distinctions; i.e. knowledge of their buyers; knowledge of current regulations; economic grasp of volume and value of products competitive to those manufactured from petroleum hydrocarbons; familiarity with products and prices of rival companies; ability to develop new outlets for their company's goods.

Among the points raised for discussion by the meeting in general was the question of how far a salesman must also be a technician; whether, in fact, technology was causing such fusion between the interest of producer and consumer that selling, without technology, is a thing of the past.

Scottish Branch

At a meeting held under the Chairmanship of Mr Robert Crichton, J.P., on January 10 in the North British Station Hotel, J. F. Field, B.Sc.,

M.I.Mech.E., M.I.E.E., M.I.C.E., Controller of the South-East Scotland Division of the British Electricity Authority, gave an address on "The Application of Gas Turbine Technique to Steam Power."

Mr Field began by pointing out the necessity for increased productivity in the U.K. to keep pace with world conditions initiated by American productivity. British economy is at the moment handicapped at every turn by shortage of coal and power. When it is realized that the American worker has, on the average, three times as much electrical drive at his disposal, the position would appear to be almost hopeless were it not that the technical and scientific approach gave ground for considerable optimism.

The limit of thermal efficiency of power generation by existing methods had been reached, i.e. 33-35 per cent with an average of 21 per cent for the British Electricity Authority. With an annual consumption of 35 million tons of coal, this meant that the equivalent of 25 million tons was lost to atmosphere, and to the cooling towers and rivers, or the sea. The reason for such low efficiencies, Mr Field pointed out, was due to the thermodynamic limitations imposed by utilizing the Rankine cycle in steam turbine practice.

However, the advent of the gas turbine, and the success of metallurgical research in providing alloys of sufficient strength for operation over long periods at elevated temperatures opened up new possibilities of vast importance.

Mr Field described a completely novel type of heat engine in which the low pressure ratio gas turbine mechanism was used, but in which steam was the working fluid. This had the thermodynamic advantages of the true gas turbine over the higher range of its temperature of operation, and of the Rankine cycle over its lower temperature range of operation. In order to use steam as a working fluid, it was necessary to have external coal firing, and undoubtedly this part of the development would be difficult, but all existing knowledge indicated that the problem would be soluble satisfactorily with the use of the new aeroplane gas turbine metals to a very limited degree in the extremely high temperature end of the heating process only. In this way power could be developed, in effect, in a gas turbine over as high a temperature range as metals were ever likely to be available for; and the exhaust, being a condensable vapour, could be used to develop further power in a normal steam turbine, which had its best efficiency, including feed heating, over the lower range of temperature. Furthermore, the exhaust steam could be taken out at any point in the cycle as might be convenient for district or process heating. The ratio of exhaust steam could be as low as 6 lb per kWh, even at the high back pressure of 150 p.s.i. as against the minimum of about 27 lb with a non-condensing Rankine cycle turbine of very large size. The inherent circulation of many times the pass-out weight of steam in the upper temperature cycle would involve high aspect ratio blading of large clearance—easy to manufacture apart from the expense of the high temperature metals—and with an exceedingly high aerodynamic efficiency compared with ordinary steam turbine blading.

Mr Field pointed out the very practical advantages resulting from the process: passing out process steam at 100 lb pressure three to four times as much electrical energy could be generated per lb of steam to process as at present, and passing out low pressure steam for district heating up to five times as much electrical energy. Moreover quite small plants could be constructed to work efficiently so that combined power and steam generation could be practised on a small scale, thus making the maintenance of a steam-power balance much easier.

Mr Field estimated that, using this technique for power generation and integrating it with the other fuel-using industries, at least 50 million tons of coal could be saved on the present aggregate output of power and heat, with a further saving of 11 million tons of locomotive coal. These savings assume a limitation of 1200°F in operating temperature. It is unlikely, however, that operating temperatures up to 1600°F will ultimately become commonplace with the new metals now available, and the savings could then certainly increase to 100 million tons a year assuming the various power uses were properly integrated on a national basis. It is not unlikely also that somewhat similar ideas applied to small power plants, e.g. motor cars, aeroplanes, etc., will ultimately increase their fuel efficiency to about double the present figure, provided the latest thermodynamic, aerodynamic, and metallurgical ideas were fully exploited. There was, of course, an immense amount of experimental development work to do before these results could be achieved, and from a purely scientific point of view the basic material upon which they could be achieved was already in existence.

South-Eastern Branch

The Inaugural Meeting of the Institute of Petroleum South-Eastern Branch took place on February 5 at the King's Head Hotel, Rochester. Seventy-three people were present, and the meeting was a great success. Noel Grey, project engineer for Kent Oil Refinery, who opened the meeting by describing briefly the events that had led up to the formation of the 7th Branch of the Institute of Petroleum, said he was pleased to say that the Institute of Petroleum had approved the formation of this Branch, which would be based on Rochester. A good deal of the credit for the formation of this new Branch was due to Mr Chatting of E. B. Badger and Mr Maliphant of Anglo-Iranian Oil Company.

Mr Grey stated that the Institute served not only the needs of the petroleum engineer, but all those allied industries without which the petroleum industry could never have attained its present position. Although the formation of the South-Eastern Branch had been initiated by members of the Anglo-Iranian Oil Company, and although the Anglo-Iranian Oil Company was in the process of building a very large refinery at Grain, it was not to be thought that those members had any desire to monopolize this new Branch. In fact it had been found that a great interest was being shown by representatives of such local industries as Berry Wiggins, Woodfield Hoist, Le Grand Sutcliffe & Gell, Blaw Knox, Wingets and others, and it was hoped that this list would grow to include all other local industries associated with petroleum technology.

Mr Grey then introduced the General Secretary of the Institute of Petroleum, who gave a short address on the aims and objects of the Institute.

Nominations were received, and the Committee elected as follows: Noel Grey (A.I.O.C.), F. A. Maliphant (A.I.O.C.), A. Chatting (E. B. Badger), R. D. Haywood (Berry Wiggins), W. A. Groves (Berry Wiggins), W. H. Lilly (Woodfield Hoist), F. W. Martin (Berry Wiggins), F. H. Sanderson (Berry Wiggins), S. H. Philpot.

Subsequently, Noel Grey was elected Chairman by the Committee, F. A. Maliphant Secretary and A. Chatting Treasurer.

By the kindness of C. S. Cleverly, General Manager of the Kent Oil Refinery, three technical films were presented: "We've come a long way," "Oil Review No. 14" and "Rig 20."

Kuwait Crude. Production of crude oil in Kuwait for the month of December, 1951, was 2,830,343 tons, total production for the period January 1 to December 31, 1951, being 27,783,170 tons.

PRESIDENT ELECT

H. S. Gibson, C.B.E., managing director of the Iraq Petroleum Co Ltd and associated companies, has been nominated as President of the Institute for the Session 1952/53.

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PRESIDENTIAL ADDRESS

The president of the Institute, Mr C. A. P. Southwell, M.C., B.Sc., will deliver his presidential address after the Annual General Meeting on Thursday, April 24, at the Institution of Mechanical Engineers, Storey's Gate, St James's Park, London, S.W.1. The subject he has chosen is "Kuwait."

The A.G.M., which is open only to Corporate Members of the Institute, will be held at the same address at 5 p.m., and, after an interval for tea, the Presidential Address will commence at 6 p.m. Visitors will be welcome at this meeting.

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PERSONAL NOTES

It is with much regret that we record the death on February 1 of **Jonkheer Ir. O. C. A. van Lidth de Jeude,** who was President of the Third World Petroleum Congress held in The Hague in 1951.

C. E. Evans, O.B.E., F.Inst.Pet., formerly works manager of the Abadan refinery, has been appointed manager of British Petroleum Chemicals Ltd.

N. L. Falcon, of Anglo-Iranian Oil Co Head Office Staff, has been awarded the Murchison Fund by the Council of the Geological Society of London.

R. H. Cruickshank has been appointed buyer for G. & J. Weir, Ltd, Cathcart, Glasgow, in succession to **Crawford T. Robertson,** who retired at the end of 1951.

M. T. Cowles, M.Inst.Pet., has been appointed to the board of directors of the Vacuum Oil Co Pty Ltd, Australia. Twenty-six years ago he joined the company as a research officer. From 1947-49 he represented Vacuum's interests in London and is now general manager in New South Wales.

Another new director of Vacuum Oil Co Pty Ltd, Australia, is **H. B. Borwick,** M.C., F.Inst.Pet., who joined the company in 1923 as a lubrication engineer. Five years later he became chief lubricating manager at head office and is now Australian industrial lubrication manager.

C. G. Kirkbride has been elected president of the Houdry Process Corporation, having been formerly vice-president in charge of research and development. **C. C. Peavy** has been elected vice-chairman and **C. H. Thayer** a member of the Houdry Board.

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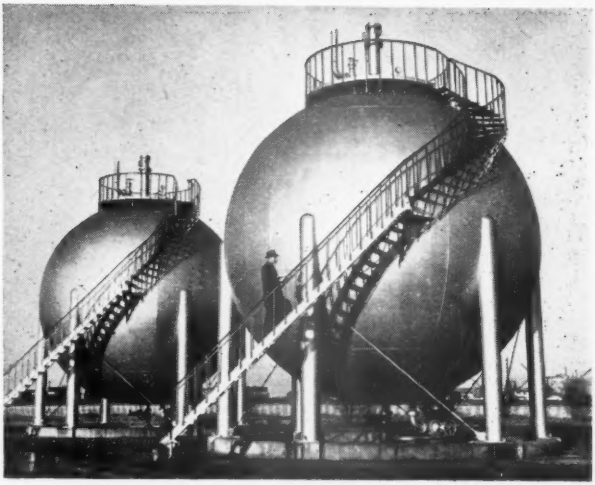
FLUIDIZATION CONFERENCE

A conference on Fluidization Technology is being organized by the Chemical Engineering Group of the Society of Chemical Industry to be held in London on June 12-13. Full details will be available later from the Secretary of the Group at 56 Victoria Street, London, S.W.1.



Two of the 54,000 gallon Hortenspheres which will be used for the storage of butane at the Grangemouth refinery of Anglo - Iranian Oil Co.

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EUROPEAN GEOPHYSICISTS ASSOCIATION

Geophysical work in Europe and the eastern hemisphere has increased considerably during the past few years and a membership of more than 400 has already been achieved by the newly-formed European Association of Exploration Geophysicists.

President of the association is A. van Weelden (Holland), vice president is D. T. Germain-Jones, A.M.Inst.Pet. (Gt. Britain), secretary-treasurer is B. Baars, F.Inst.Pet. (Holland) and the headquarters are at 30 Carel van Bylandtlaan, The Hague.

At the first technical meeting on December 15, 1951, after the President had given a review of geophysical work in Europe since the end of the war, the following six papers were presented:—

"Geometric problems originated by reflection seismic in mines" by Dipl. Ing. Linsser (Germany). "The design of electromagnetic geophones" by A. T. Dennison (England). "Gravity effect of earth tides" by B. Baars (Holland). "Earth tilts and the flow of oil wells" by R. Tomaschek (England). "Sur le calcul de l'influence gravimétrique des structures definies par les isobathes; application à la correction topographique" by V. Baranov (France). "Some examples of the application of isostasy" by J. W. de Bruyn (Holland).

Arrangements are being made to hold the next meeting at Manson House, 26 Portland Place, London, on May 22 and 23.

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INTERNATIONAL STANDARDS

Eleven technical committees of the International Organization for Standardization, including committee ISO/TC 28 on petroleum products, are to meet in New York this Spring in connexion with the triennial meeting of the ISO at Columbia University from June 9-21, 1952.

ISO's president is M. Albert Caquot, president of AFNOR, the French Standards Association.

OIL SHALE CONFERENCE BOOK

In 1938 the Institute of Petroleum organized and held the First Oil Shale and Cannel Coal Conference and the published proceedings of that conference constituted a standard reference book on the subject of retortable oil-yielding materials.

After the war it became obvious that developments since 1938 had been such as to warrant the holding of a second conference. Consequently, in June, 1950, the Second Oil Shale and Cannel Coal Conference convened in Glasgow and fifty papers were read and discussed. These papers and a report of the discussion form the present volume (Oil Shale and Cannel Coal, Vol. 2) and the more than 800 pages are the last word on the subject of oil shale and shale oil. For many years this book will remain the standard work of reference on the subject.

All aspects of oil shale and shale oil are covered—mining, retorting, refining, utilization, and assay.

Copies of the volume may be obtained from the Institute at 63*s* each, post free.

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DATA ON AVIATION PRODUCTS

"*Thrice fortified is he in all his acts,*
Who forthwith can put his finger on the facts."

Many of us know how difficult and time-consuming it can be to find just that particular fact we need to decide some point or other. In the field of aviation fuels, lubricants and hydraulic fluids, the Aviation Products Data Committee of the Institute are co-operating with the Fuels and Oils Sub-Committee of the Royal Aeronautical Society in the preparation of data sheets, which will collect the available information in convenient loose-leaf form.

These data sheets are to include notes on the various properties, specifications, and not only the ranges of normal inspection data, but also other properties on which data are not readily available, and charts to simplify calculations.

The Data Sheets on Aviation Fuels were published in 1950, and include information, for example, on specific heats of vapour and liquid, latent heats, inflammability limits at various altitudes, dielectric constants, solubility of air and water, relation between vapour pressure and flashpoint, and between vapour pressure and temperature. So far as possible the data have been given in a form permitting general application.

These Data Sheets on Aviation Fuels, in a substantial stiff-covered loose-leaf folder, can be obtained from the Royal Aeronautical Society, 4 Hamilton Place, London, W.1, at a price of 35*s* 6*d* per set (23*s* 6*d* to members of the Society or the Institute).

The Aviation Products Data Committee are now actively engaged in collecting similar data sheets on aviation lubricants for inclusion in the loose-leaf folder already published, and it is hoped that these additional sheets will be available during 1952.

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"BOOK OF THE JET"

This handsomely produced booklet contains a simple account by Arthur Elton of the gas turbine, copiously illustrated by diagrams. Also given is a list of suggestions for further reading and a table of British aircraft introduced between D-Day and September, 1952.

But the most striking feature of the booklet, which is issued by Shell-Mex and B.P. Ltd, is an ingenious series of transparent drawings, illustrating a gas turbine "in the round." As each sheet is turned over a further step in the "taking down" of the jet is revealed.

Buoyant Foundations in Soft Clay for Oil Refinery Structures at Grangemouth. C. W. Pike, A.M.I.C.E., and B. F. Saurin, B.Sc., A.M.I.C.E., Institution of Civil Engineers, Great George Street, London, S.W.1, 5.30 p.m., March 25.

OIL AND TRANSPORT

The Institute of Transport's Henry Spurrier Memorial Lecture for 1951 was given in December by Christopher T. Brunner, F.Inst. Pet., M.Inst.T., director and general manager of Shell - Mex and B.P. Ltd. Mr Brunner, whose paper was entitled "The Pattern of the Oil Industry," gave a comprehensive picture of the industry with particular regard to its close connexion with and dependence upon the service of transport.

An outstanding characteristic of oil, Mr Brunner pointed out, is its exclusiveness in transport matters, Not only is it a liquid, a fact which separates it from most other articles of commerce, but in many of its forms it is an inflammable liquid, and in all its forms is a liquid which would contaminate other liquids using the same instruments of transport.

The total amount of transport concerned with oil marketing is considerable. Taking as an index the cost to the oil company, the sum paid out to the railways by oil marketers in Britain is equivalent to about 2 per cent of total railway receipts from freight traffic of all kinds, including coal and minerals.

The cost of the oil companies' own and hired road vehicles is about double the payment made to the railways, while the cost of own and hired water transport, including coasters and barges but, of course, excluding ocean-going tankers, is almost equal to the payments to the railways. The oil marketing companies are operating some 5,800 road tank vehicles in the United Kingdom, most of them in the larger categories.

Oil is the most important single commodity in world trade, with a value of over £1,000,000,000. In referring to Britain's stake in world oil, Mr Brunner said that British and British-Dutch companies accounted in 1950 for over 40 per cent of the oil going into the world export and import trade. In the same year, British firms manufactured oilfield and refinery equipment and pipelines valued at £70,000,000, of which about £50,000,000 worth was exported. Britain was responsible for no less than 56 per cent of all tanker tonnage now being built throughout the world. British refinery capacity, 3,500,000 tons in 1939, had risen to 20,000,000 tons in 1951, and is planned to reach 26,000,000 tons in 1953 as part of the Western European countries' objective of 60,000,000 tons.

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The British Skill, launched on January 16 by Lady Slim, for the British Tanker Co., completes the six 28,000-ton tankers ordered by the Company.

FIGHTING AN OILFIELD FIRE

The Anglo-Iranian Oil Company's dramatic, newly completed film of an oilfield fire was shown to members of the Oil Industries Club at their luncheon in December.

Entitled "Rig 20," the film shows the struggle to put out the huge blaze at Naft Safid, in Southern Persia, when a well caught fire last spring. The extinguishing operation was directed by Myron Kinley, the American expert on oilfield fires.

This was the only serious fire in 40 years in the Company's Persian fields, but the film emphasizes the gigantic subterranean forces which can be loosed accidentally during drilling operations, and the great and dangerous effort needed to resume control over them.

A particularly impressive shot is that of half a mile of 4½-inch pipe being flung a thousand feet into the air and twisting like string after a charge had been exploded to clear wreckage from the well-head.

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1951 MOTOR RACING FILMS

Two exciting and well-made new films, featuring 1951 events in the fields of European motor and motor cycle racing, were recently shown by Castrol in London.

"European Motor Racing" covers six international events, including the Grand Prix d'Europe, won by the 1951 world champion, Fangio, in a typical French gala atmosphere; the British Grand Prix at Silverstone, the soaking wet international 500 cc meeting on August Bank Holiday, which the commentator aptly described as "Brands Hatch Regatta"; the R.A.C. tourist trophy, won by popular Stirling Moss in a Jaguar; the Prescott Hill Climb, always a lively spectacle, and finally the German Grand Prix at Nurburgring, where a particularly fine course is enhanced by a beautiful setting of mountains and forest. The film, which is in Kodachrome and lasts about 40 minutes, was produced by Richard Habershon, himself a racing driver.

The other film, also in colour and of the same length, is "Motor Cycle World Championships." It tells the story of the eight classic races, which together qualify riders for the title of world champion. Starting with the Spanish Grand Prix, run against the gay background of Barcelona, the producer, S. A. Coles takes us to Switzerland, the Isle of Man, Belgium, Holland, France, and Northern Ireland, finishing up at Monza for the Grand Prix des Nations.

These films are available for distribution to motor and motor cycle clubs throughout Great Britain and enquiries should be addressed to C. C. Wakefield & Co., Ltd., 46 Grosvenor Street, London, W.1.

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PETROLEUM IN PARLIAMENT

Barbados Concessions

On January 20 the Secretary of State for the Colonies was asked what concessions had been granted by the Government of Barbados to the Gulf Oil Co to prospect for oil, and how these compared with those granted to the British Union Oil Co.

In an oral reply Mr Lyttelton said: The British Union Oil Co received the first offer of prospecting rights over 55 per cent of the Island with the first choice of area. The Company rejected the offer and broke off negotiations with the Barbados Government. The Gulf Oil Corporation subsequently took up rights over 50 per cent of the Island.

I hope that the British Union Oil Company will apply for rights over the 50 per cent of the Island which is still available for prospecting.

PETROLEUM AND THE TEXTILE INDUSTRY*

By F. N. McLAREN†

In a survey of the many uses of petroleum by the textile industry it is appropriate first to make some reference to the industry itself.

Textile production falls into a number of major groupings which deal primarily with the different fibres, natural and man-made. There is some overlapping, since nowadays combinations of different fibres are often used in the products which reach the consumer. Nevertheless, it is not difficult to recognize the existence of separate groups within the structure of the industry as a whole: the woollen, cotton, linen and jute industries, for example, and the comparatively young but very healthy newcomers which produce the regenerated and synthetic fibres such as the rayons and nylon.

Textile Manufacture

The Woollen Industry

Historically, pride of place belongs to the woollen industry. Indeed the woollen industry is the mother industry from which sprang Britain's present-day complex textile activities, and on which was founded Britain's considerable export trade.

The foundations of the wool industry go back to Saxon times, but it was the 18th century that saw the beginning of the factory age in Britain, made possible largely by the inventions of Hargreaves, Kay, Arkwright and Crompton, who each made major contributions to the mechanization of the textile industry.

A plentiful supply of water power was available in the West Riding of Yorkshire. Later on, coal and iron were found nearby, and the construction of canals furthered the development and expansion of the industry. In the 19th century this industrial growth in Yorkshire and Lancashire reached full stature.

The Cotton Industry

The cotton industry is located mainly in Lancashire and the adjacent parts of Cheshire, Derbyshire, and Yorkshire. In October, 1939, more than 95 per cent of all Britain's cotton spinning operatives were employed in this area, and this figure is still substantially correct.

Lancashire is an old home of the textile industry. Wool was being processed there nearly 800 years ago, and linen a little later. Cotton was first introduced about 1600, being then treated in mixture with flax. With the introduction of the new spinning machinery, and the advent of steam power, cotton came to predominate. The humid conditions which prevail in the Lancashire area favour the manipulation of the cotton fibre by enhancing its elasticity and minimizing the effects of static electricity.

During the golden years before the first world war, Lancashire was supplying two-thirds of the world's cotton imports, but since then competition from overseas has made increasing inroads into our export trade.

Since the second world war the industry has been engaged in helping to meet a world-wide shortage of consumer goods, so that stable conditions have not been attained. Competition from Japan, is however again becoming noticeable. Meanwhile, the cotton industry is making a determined effort to put its house in order so that when more competitive times return it will be better able to maintain its place in world markets. Re-deployment of labour and re-equipment with modern processing machinery are important aspects of

*Summary of a lecture given at the London Branch of the Institute, February 21, 1951.

†Esso Petroleum Co.

this activity, and the latter will have its effects on the materials supplied by the petroleum industry.

The Rayons and Nylon

Earlier mention was made of regenerated, as distinct from natural or synthetic fibres. Under this class come the rayons. "Artificial silk," as it used to be called, is made from cellulose derived via wood pulp from spruce logs.

Production of rayon has increased spectacularly since the days, around the turn of the century, when the new materials were first developed. New uses for rayon are continually being found, and in addition to this a world shortage of wool, recently spotlighted by alarming increases in price, will swell the demand. The versatility of rayon allows it to be used as an extender for the natural fibres, quite apart from its usefulness in its own specialized fields.

The production of nylon yarn is now being undertaken on a considerable scale in a new plant located on the eastern fringe of the South Wales Development Area. Here, near Pontypool, British Nylon Spinners Ltd. have built what is claimed to be the biggest multi-storey factory under one roof in Europe, with a million square feet of floor space.

Petroleum in the Textile Industry

Petroleum and its related products used by the textile industry can be grouped under three main headings, fuels, lubricants, and process materials.

Fuels

The traditional, and still widely used, way of driving the machines in a textile mill is by the steam engine. Examples can be quoted of mills which are still driven by venerable beam engines, some more than a hundred years old. But most of the steam engines in use are of more modern design, many having been installed around and subsequent to the turn of the century.

Some conversion from coal to oil firing has taken place, and more will follow when the present difference in cost disappears.

In the textile industry individual electric driving is becoming standard practice, and very few new machines are being coupled to steam-driven line shafting. This method has been proved to be a sound proposition in every way; it leads to economies in running costs, confers greater flexibility, and reduces labour requirements. The various post-war government working parties, have recommended its adoption as one of the ways by which the industry can become a better competitor in world markets.

As a result, many firms are taking a supply of electricity from the grid, but others are installing their own generating equipment. In some cases this involves the installation of diesel- or turbine-driven generating sets, but quite often the existing prime mover, a steam engine, is harnessed to the new generator.

Many textile plants, particularly those engaged in dyeing and finishing, require large amounts of process steam. In such cases, if the steam raising plant is in good condition, there is a good argument in favour of retaining a steam-powered prime mover, since exhaust steam is suitable for many textile process uses.

Another aspect of the argument for retaining the steam engine which cannot be ignored is the inherent reliability of the equipment.

There is, however, a good prospect that consumption of diesel fuel by the textile industry will increase during the coming years. As boiler plant becomes old and unserviceable the widespread adoption of individual electric driving will cause many firms to instal diesel generating-equipment, if only to provide an auxiliary supply of electricity. This trend is likely to be most noticeable in the spinning and weaving sections of the cotton and worsted industries, which use little or no process steam.

Nor should it be forgotten that the oil industry is making an important, and perhaps vital, contribution to the reliability of the modern diesel. At the same time, efficiency ratings are continuing to rise, and no one in the oil industry concerned with the improvement of diesel fuels and lubricants can afford to rest on past achievements.

Lubricants

When the lubricating oil requirements of the textile industry are studied in detail it becomes apparent that the industry has a number of problems that are worthy of investigation. In general, speeds are high and loads light, though there are exceptions, particularly in the case of certain machines used in printing and finishing plants. However, appearances are sometimes deceptive.

In the first place, many of the machines are old and in poor condition, and this can partly be explained by the fact that no major changes in processing techniques have been evolved until comparatively recently. The methods of lubrication are often simple in the extreme, and it is a fact that the oilcan is still the most commonly used lubricating device.

Oil Stains

As a result of the methods of lubrication employed, staining troubles are not uncommon. For many years it has been customary to use oils which are relatively easy to wash out of yarn or fabric, these oils being compounds of mineral oil with fatty oils such as sperm, whale, rape, lard, neatsfoot, etc. When the soiled yarn or materials is given a scouring or bleaching treatment the fatty oil forms soap with the alkali which is usually present, thus assisting in the removal of the mineral oil portion of the blend.

Fatty oil blends, however, are not without defects. The tendency towards excessive oxidation and polymerization manifests itself in gumming and thickening in bearings, while oil stains on textile materials become more difficult to remove as degradation of the fatty oil constituent proceeds. In many types of textile production there frequently elapses between the time when the yarn is made and the piece is finally scoured or bleached, an interval of weeks or months, during which a comparatively harmless spot of oil can cause a permanent stain.

Moreover, many stains on textiles are caused not by the oil, but by other materials which the oil carries with it. Finely-divided iron and brass worn from bearings, often present in the oil, can cause severe and permanent staining, and various kinds of dirt from floors and atmosphere also play their part.

It is true that much of the modern textile machinery is better designed from the lubrication point of view. Closed systems of lubrication are becoming more generally used, and centralized lubrication devices are a further improvement. Sintered metal bearings and grease-lubricated ball- and roller-bearings further reduce the risks of staining.

Tacky Oils

At the present time the oil industry is approaching a solution to this problem from two directions: prevention and cure. Prevention consists in doing everything possible to stop the oil from reaching the materials being processed, one way being to use tacky oils. It is now well known that additives are available which impart to an oil non-drip and non-throw characteristics out of all proportion to the oil's viscosity, and oils compounded in this way are being used very successfully in a number of textile mills. The chief objection to their use arises from the fact that it takes longer to oil a machine with a tacky oil than it does with a straight or conventionally compounded mineral oil. Oiling in a textile mill is usually done hurriedly by unskilled labour, the

result being fine streaks of oil from bearing to bearing, which sometimes reach the materials in process of manufacture. This is a matter for the mill managements to put right, for a little extra time taken in oiling a machine with tacky oil is more than repaid by the reduced frequency of lubrication which becomes possible because the oil stays where it is wanted so much longer. Some people believe that tacky oils tend to increase accumulations of lint and fluff round bearings, but the writer does not believe that this is so. Any textile fibre loses much of its mobility when soaked with oil, tacky or otherwise, and will not stray far from its point of contact with the oil. If anything, the reduced tendency to creep along metallic surfaces should limit the size of accumulations of oil soaked lint and fluff.

Emulsifiable Oils

The other approach is by way of making improved washable or scourable oils. Many different types of emulsifiers are now available for incorporation in mineral oil, and some of these make possible the formulation of oils which are more easily removed than the conventional fatty oil blends. In addition, such oils do not suffer from the disadvantages of conventionally compounded oils, and possess excellent chemical stability. There is also some evidence that these newer types of oil assist materially in the removal of solid contaminants which they themselves may carry, and work on this aspect of performance is receiving attention.

Power savings due to reduced fluid friction in the lubricant is another field in which progress has been made. In spindle lubricants, for instance, it has been found possible to make useful power savings by reductions in viscosity, at the same time maintaining film strength at the necessary level by the use of additives. In spindle oils, too, the tendency to sludging has been much reduced by the use of other additives, with attendant power savings and increased lubricant economy.

Future Trends

It is not within the scope of this paper to discuss in detail all the lubricant requirements of the textile industry, but some mention should be made of future trends which are likely to affect the oil industry as re-equipment proceeds.

There is evident an increased awareness of the need for correct lubrication, and a tendency to inquire more closely into the types of oil available. This is in part due to the activities of the oil industry, and in part to the large-scale re-equipment now in progress. The tendency to use inexpensive "once-through" lubricants will change as the newer types of machine are installed and it can be expected that in the years ahead there will be an increasing demand for a better class of lubricant. This will result in a reduced overall demand for lubricating oil unless some unexpected expansion in the industry takes place. Apart from the fact that the new machines use less oil than the old, new short-cut processing techniques make possible the elimination of many machines. Thus, for instance, the new high-draft speed frame fulfils the functions of the slubbing, intermediate and roving frames, at the same time using less oil and grease than any one of them.

The development of spindles fitted with life-packed ball-bearings, already widely used in the U.S.A. is another example. These spindles operate for as long as 30,000 working hours without attention, and their widespread adoption in the U.K. would inevitably lead to a contraction in the market for spindle oils. On these figures, something like 3 litres of spindle oil will be replaced by a teaspoonful of grease.

Taking the long view, it seems probable that over the years a gradual change will take place in the types of lubricants supplied to the textile indus-

try. Instead of supplying comparatively large volumes of inexpensive grades, the oil industry will be called upon to provide better quality and more specialized—hence more expensive—lubricants. Future research should, therefore, be along these lines, and it will entail a closer study of machine components and mill conditions than has been made hitherto.

Process Oils and Materials

The textile industry offers a large and expanding market for process oils and materials, and in this field the petroleum industry has excellent prospects. Process oils are used in the production and preparation of yarns from all the principal natural and man-made fibres. Petroleum solvents and waxes enter into other aspects of textile production, and detergents made from raw materials derived principally from petroleum are in increasing demand.

Wool Oils

Process oils are used in the woollen industry as fibre lubricants. The wool fibre has a rough surface composed of tiny overlapping scales, and a lubricant is necessary if these are to slide freely and without damage over one another during such operations as carding, combing and gilling. Any lubricant which is used must be capable of easy removal after it has fulfilled its purpose: that is, at some stage in manufacture subsequent to spinning. If left in the yarn it would for example interfere with subsequent manufacturing processes such as dyeing or raising, and would impart an objectionable odour or feel to the goods.

In worsted production it has been usual to use vegetable oils such as olive and arachis, while the woollen process uses oleines of varying degrees of purity and free fatty acid content. The former materials are removed by emulsification, the latter by saponification scouring.

In recent years some progress has been made with the development of petroleum-based substitutes for the conventional process materials, and a number of British manufacturers are following the lead of American and Canadian firms which have turned to these materials. Such oils must be readily removable, preferably by existing methods and the achievement of this is no easy matter. But it can be done and, given easy scourability, petroleum-based wool oils offer the user a number of advantages arising from the superior stability of the raw materials.

Dust Suppression in the Cardroom

In the carding of cotton, during which is prepared sliver for subsequent drawing and spinning operations, a good deal of microscopic dust and short fibre is released into the atmosphere of the cardroom, and even when a modern air-conditioning plant is installed, severe discomfort and permanent damage may be caused to the respiratory system, particularly in the case of sufferers from such ailments as asthma and chronic bronchitis.

The use of about 0.25 per cent of a light mineral oil in an oil-in-water emulsion has brought about an improvement which has to be seen and felt to be believed. During the treatment which precedes carding, the emulsion is applied to the cotton in the form of a fine spray. Although it can only be assumed that the materials normally released to the cardroom atmosphere are retained in the cotton, it is agreed by all concerned that no deterioration of yarn quality is apparent. Although a relatively small market, the petroleum industry has here made a most useful contribution to the improvement of working conditions in the cotton mill.

Rayon Oils and Raw Materials

The rayon industry is a large consumer of process oils, generally of low viscosity. Such oils are used as fibre

lubricants and as delustrants. The continuous viscose spinning process consumes large quantities of such oils, in which are incorporated emulsifiers so that a stable oil-in-water emulsion is formed. This is applied to the rayon filament during the processing.

Petroleum, however, enters much earlier into the production of acetate rayon, since from it are derived the raw materials for production—acetic acid, acetic anhydride, and acetone, which are in turn obtained from ethyl alcohol and *iso*propyl alcohol.

Many of the chemicals derived from petroleum are used in the production of textiles, both directly and indirectly, and developments in recent years of the true synthetic fibres such as nylon, vinyon, and terylene open up additional avenues of expansion, since these materials can also be synthesized from petroleum.

Detergents

Detergents based on petroleum products are also finding many uses in the textile industry. At various stages of manufacture their remarkable ability to reduce the surface tension of water is particularly valuable, and they are of course used in many scouring and washing processes. In this field the market appears to be capable of further expansion, for much soap is still used in the mills.

Solvent Degreasing of Wool

Wool contains a great many impurities including woolgrease, sweat, dust, vegetable seeds, branding paint, etc., which before processing can begin must be removed by a washing process. The generally used system is saponification scouring in which a mild alkali reacts with the wool grease to form an oil-soluble soap. Recently, progress has been made with a solvent degreasing technique, and although the difficulties to be overcome are formidable the early reports are encouraging. New equipment will be needed in the mills, and fire hazards will have to be overcome. But many thousands of tons of wool are processed in Britain every year, and if solvent degreasing is ever adopted in the U.K. on a large scale a considerable new market will open up, even when allowance is made for a high rate of solvent recovery.

In a paper of this nature it is not possible to explore fully all the many uses, and possible uses, of petroleum products by the textile industry. Many of these have not been mentioned, including the application of batching oils to the coarse natural fibres such as jute, hemp, and sisal, and the employment of petroleum waxes and solvents in the waterproofing trade.

Looking into the future, it is possible to see an increasing market for fuel and diesel oil, and a diminishing, but more specialized, market for lubricants. On the process oil side there is much scope for expansion, while petroleum chemicals are only on the threshold of a period of intensive development, during which the textile industry will become an even more important customer than hitherto. Increasing demand for regenerated and synthetic fibres is likely to play an important part in this expansion of markets.

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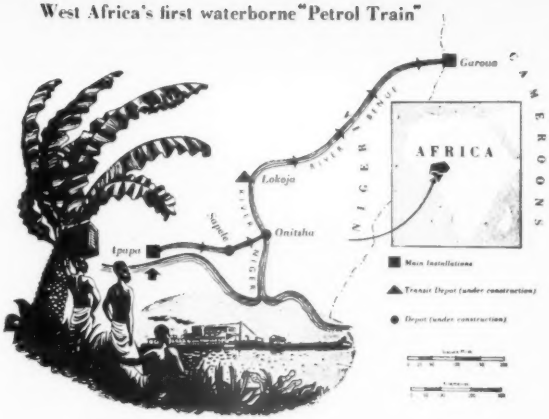
CONFERENCE ON CLAYS

A conference on clays and clay technology will be held at the University of California, Berkeley, from July 21-25, 1952, under the chairmanship of Dr R. E. Grim. Among the subjects to be covered is the importance of clay technology in the petroleum industry. Further details are obtainable from W. H. Somerton, assistant professor of petroleum engineering, University of California, Berkeley 4, California, U.S.A.

West Africa's first waterborne "Petrol Train"

Six 200-ton capacity barges form part of the "petrol train" which will transport petrol in bulk from Apapa, near Lagos, up 1,200 miles of waterways to the bulk depot at Garoua, French Northern Cameroons. This £350,000 project has been developed by Shell and Socony Vacuum.



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EXPLORATION IN PAKISTAN

The drilling of a series of core holes north east of Sylhet town was commenced by Pakistan Petroleum Ltd. at the end of November 1951. The holes will be drilled to a depth of 4000 ft to obtain geological information on this area.

After drilling, each hole will be electrically surveyed to measure the electrical properties of the rock penetrated.

By the end of December the Company reports, the first hole in Sylhet has been drilled to 1500 ft.

In Patiya, Chittagong District, it is planned to drill a deep test well, to a depth of 14,000 ft if necessary. Preliminary work is being carried out. This involves constructing an approach to the densely wooded location near the Karnafuli river and establishing a camp.

The objective of the Patharia well was reached on December 11 and work began on testing the sands.

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FORTHCOMING MEETINGS

THE INSTITUTE

A Comparison of the Fixed-bed, Liquid-phase ("Slurry") and Fluidized-bed Techniques in the Fischer-Tropsch Synthesis. C. C. Hall, M.Sc., Ph.D., D. Gall, M.A., B.Sc., Ph.D., and S. L. Smith (*Fuel Research Station, D.S.I.R.*). At 26 Portland Place, London, W.1, 5.30 p.m. (*tea* 5 *p.m.*), March 26.

Some Observations on Corrosion in Engineering. S. F. Dorey, C.B.E., D.Sc., F.R.S. At 26 Portland Place, London, W.1, 5.30 p.m. (*tea* 5 *p.m.*), April 9.

The Distribution of the World's Oil Reserves. G. M. Lees, M.C., D.F.C., Ph.D., F.R.S. At 26 Portland Place, London, W.1, 5.30 p.m. (*tea* 5 *p.m.*), May 14.

Fawley Branch

Chemicals from Petroleum. E. B. V. Potter. At Esso Recreation Club, Holbury, 7.30 p.m., April 16.

London Branch

Fawley Refinery. G. Noble, B.Sc., A.M.I.C.E. At 26 Portland Place, London, W.1, 6 p.m. (*tea* 5.30 *p.m.*), April 22.

Northern Branch

Motor Racing and Record Breaking. Captain G. E. T. Eyston. At Engineer's Club, Albert Square, Manchester, 2, 6.30 p.m., April 22.

Scottish Branch

Rothes. G. Mullin. At Glasgow, April 3

OTHER SOCIETIES

Importance of Lubrication to the Works Manager. H. O. Bates. Institution of Works Managers, Sheffield Branch. At Grand Hotel, Sheffield, 7.30 p.m., April 1.

Heat Transfer to Boiling Liquids at Low Temperatures and Elevated Pressures. A. G. Monroe, H. A. Bristow, and J. E. Newall. At Burlington House, London, W.1, 5.30 p.m., April 8.

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APPOINTMENTS VACANT

Berry Wiggins & Company Ltd. require for London Office an **Assistant Engineer** preferably under 30, with technical and practical training in mechanical engineering and drawing office experience.

Duties are of a general character and include plant operation records, maintenance and constructional work on oil refinery plant and equipment including layout, and preparation of specifications. Previous experience in similar work preferable.

Applications stating age, experience and salary required to Staff Manager, **Berry Wiggins & Co. Ltd.,** Field House, Breams Buildings, Fetter Lane, London, E.C.4.

Chief Engineer required for oilfield equipment manufacturers based in England. Must have knowledge modern drilling and production equipment design and operational techniques, with background foreign oilfield service preferably in the Americas. Excellent opportunity to right man for high advancement. Full details, which will be treated in strict confidence, to Box 1065, *IP Review*.

Manager required for an expanding oil storage installation on the Thames, handling both heavy and light mineral and vegetable oils and also petroleum spirit.

The installation includes a tanker berth, barge berths as well as road and rail access.

Imperative that applicants have had previous experience in charge of similar installation and be familiar with the handling of all types of liquid cargoes. A full knowledge of Customs requirements and formalities essential. Applicants must be able to supervise staff. A pension scheme is in operation. Salary according to qualifications and experience.

Applicants should write fully stating qualifications, age and experience to Box 5567, c/o Charles Barker & Sons Ltd., 31 Budge Row, London, E.C.4.

Monsanto Chemicals Limited require the services of a **Chemist** for a senior position in a group working on application research and technical service problems associated with the use of chemical additives in petroleum products, at laboratories near London.

Applicants should possess good academic qualifications, should have had post-graduate research experience and, preferably, some experience in the Oil industry.

The post, which is pensionable, offers good prospects to candidates possessing initiative and vision. Salary will be commensurate with qualifications and experience.

Applications, which will be treated in strict confidence, should be sent to the Chief Personnel Officer, Monsanto Chemicals Limited, Allington House, Allington Street, London, S.W.1, and should contain full details of age, experience, and qualifications.

Three or Four Contract Engineers required immediately by **Kellogg International Corporation, London.** Should have University training with degree, working knowledge of mechanical engineering, physical chemistry, knowledge of metals, and have spent eight to ten years or more in industry. These are new posts and are required for expansion programme for petroleum refinery, and chemical plant design and construction, but applicants considered with good coke oven, gas works or sugar refinery practice. Duties would consist of producing from finished process data and flow sheets, etc., specification of equipment such as large fractionating columns, heat exchangers, calculation of piping, pumps and associated steel structures, instrumentation, etc. Good salaries and future with executive status to really suitable high calibre men with requisite ability and experience. Applications stating details of age, education, experience, in strict confidence to C.W.K., Box 1067, *IP Review*.

Trinidad Leaseholds Limited have vacancies for **Chemists** in their research laboratories in Trinidad. Applicants should be University graduates with physical or organic chemistry as a field of specialization and with a number of years experience in petroleum or allied research, either academic or industrial. The minimum salary will be £880 per year with marriage and family allowances in addition. Apply with full particulars to the Personnel Officer, Trinidad Leaseholds Limited, Old Burlington Street, London, W.1.

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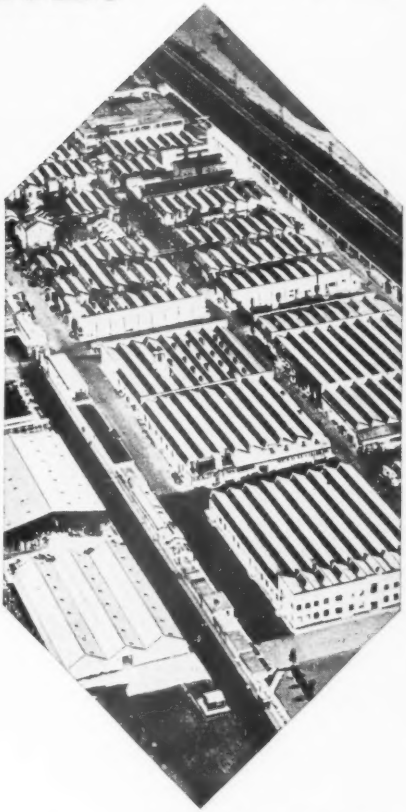

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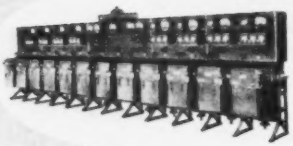

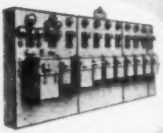

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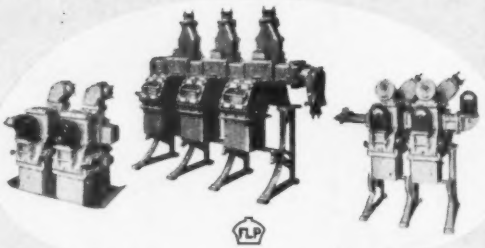

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Here is a foam compound that will kill any oil or petrol fire with speed and certainty. Nicerol is a concentrate, producing a heavy-type foam of closely knit small bubbles which form a tough vapour-tight blanket over any surface of burning oil or petrol. It is characteristic of Nicerol Foam that it flows with the fire and is highly resistant to flash-back or re-ignition. It can be used successfully in any type of mechanical foam or air-foam apparatus—is equally effective with ***salt*** water or ***fresh*** and can be stored for years without deterioration.

★ **The Royal Navy and the Royal Air Force use it and so do Oil Companies, Fire Equipment Manufacturers, Civil Air Lines, several Commonwealth and Foreign Government departments, and Fire Brigades throughout the world. What better recommendation.**

★ **Nicerol is supplied in new heavy gauge steel drums specially designed to permit quick release and clean pouring of contents. These are supplied in 2, 5 or 40 Imperial Gallons capacity. 3 gallons of Nicerol will produce over 1,000 gallons of pure white foam.**

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(Associated with the Burnhouse Organisation)

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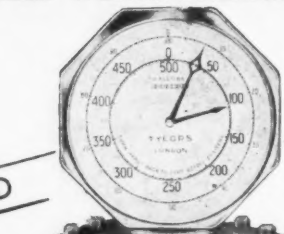

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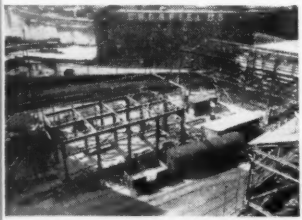
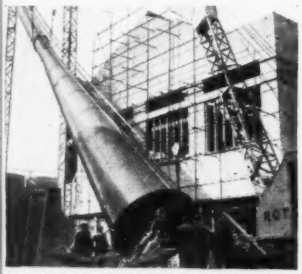


Erection of Silo Steelwork, foundations for storage tanks and construction of oil fuel tanks



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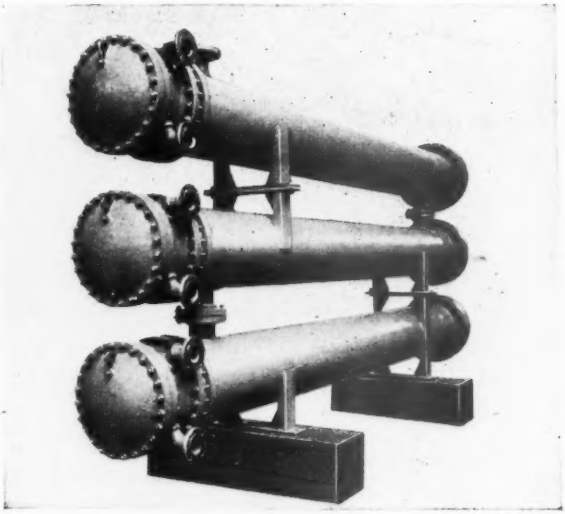

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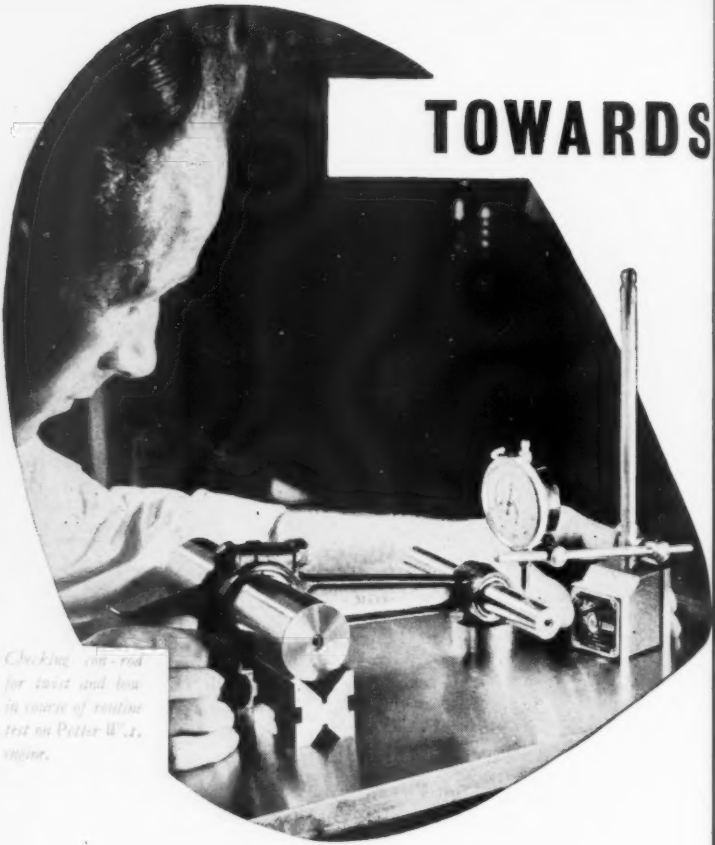

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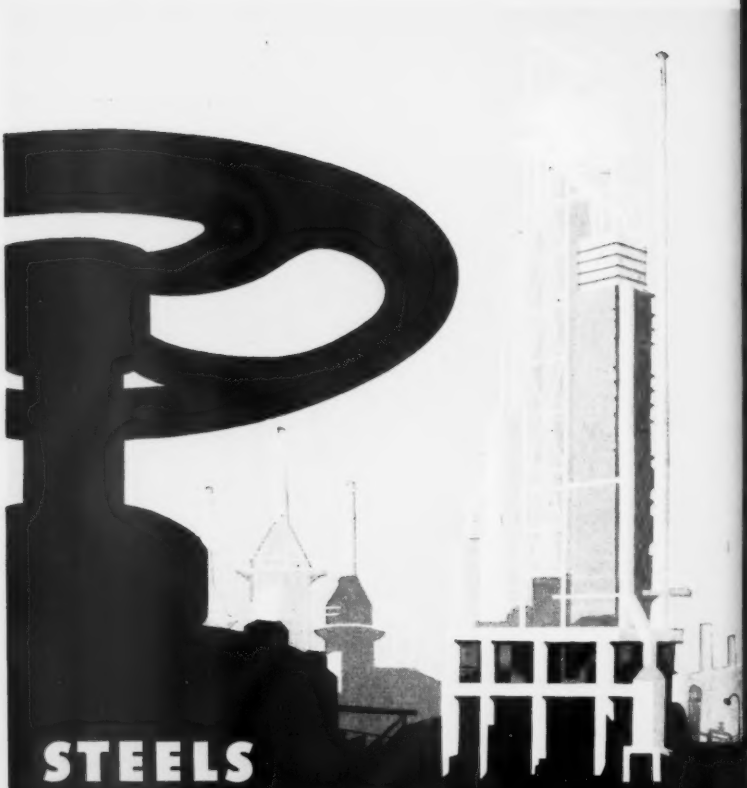

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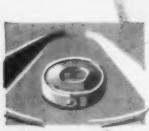

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